DYNATEL
500

CABLE LOCATOR
MAINTENANCE INSTRUCTIONS

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FORM 7999-0008

TABLE OF CONTENTS

Section/Paragraph		Title	Page
I		INTRODUCTION	1-1
	1-1	Scope	1-1
	1-4	Maintenance	1-1
II		TRANSMITTER CIRCUIT DESCRIPTION	2-1
III		TRANSMITTER MAINTENANCE	3-1
	3-1	Disassembly Procedure	3-1
	3-6	Transmitter Performance Test	3-1
	3-8	Transmitter Adjustment and Alignment	3-2
	3-9	Troubleshooting	3-3
IV		RECEIVER CIRCUIT DESCRIPTION	4-1
V		RECEIVER MAINTENANCE	5-1
	5-1	Disassembly Procedure	5-1
	5-9	Receiver Performance Test	5-1
	5-13	Adjustments	5-3
	5-17	Troubleshooting	5-4

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1	Transmitter Assembly A1 Functional Block Diagram	2-2
3-1	Transmitter Circuit Assembly A1A1 Assembly Diagram	3-5
3-2	Transmitter Schematic Diagram	3-9
4-1	Receiver Assembly A2 Functional Block Diagram	4-3
5-1	Receiver Antenna Assembly A2A1 Assembly Diagram	5-9
5-2	Receiver Circuit Assembly A2A2 Assembly Diagram	5-10
5-3	Receiver Circuit Schematic Diagram	5-13

LIST OF TABLES

Table	Title	Page
3-1	Transmitter Troubleshooting	3-3
3-2	Parts List, Transmitter Assembly A1	3-6
5-1	Receiver Troubleshooting	5-5
5-2	Audio Troubleshooting	5-6
5-3	RF/IF/Oscillator Troubleshooting	5-7
5-4	Meter Circuit Troubleshooting	5-8
5-5	Parts List, Receiver Assembly A2	5-11

SECTION I
INTRODUCTION

1-1. SCOPE

1-2. This manual is a limited edition maintenance supplement to the Model 500 operating instructions, and contains only pertinent maintenance information. Battery test and replacement information is contained in the operator's instructions.

1-3. This manual is divided into two major independent sections: the transmitter information is covered in Sections II and III, and the receiver information is covered in Sections IV and V. Sections II and IV are brief circuit descriptions of the two units. Schematic Diagrams, Assembly Diagrams and Parts Lists are contained in Sections III and V for each unit.

1-4. MAINTENANCE

1-5. General

1-6. The Transmitter Assembly A1 consists of two assemblies that are mounted in the carrying case:

- The Printed Circuit Board and Panel Assembly A1A1
- The Transmitter Antenna Assembly A1A2

The Receiver Assembly A2 — which is normally stored in the transmitter/carrying case unit — also consists of two assemblies:

- The Printed Circuit Assembly A2A1
- The Antenna Assembly A2A2

1-7. Periodic Maintenance

1-8. No periodic maintenance — such as lubrication or cleaning — is required. All units are designed for a minimum of adjustments, and these, in turn should normally be required only if components have been replaced. All printed circuit, switch and transformer assemblies are sealed or otherwise protected against dust and humidity, so that cleaning is not necessary unless the unit is being repaired.

NOTE

All transformers are protected with self-adhesive paper covers and then painted. Replace with new covers after replacing or adjusting transformers.

1-9. For best results, the performance of the transmitter and receiver units should be checked periodically. If the units are used infrequently, it may be convenient to check performance when the batteries are replaced. On the other hand, if the unit is subjected to rough use, or it is used in a severe environment (dusty, humid, hot, cold, etc.), performance should be tested more frequently; for example, quarterly checks might be convenient.

1-10. Required Test Equipment

1-11. The following items are required for performance testing, troubleshooting, and adjusting the Model 500:

(1) Analog voltmeter with high input impedance; Hewlett-Packard Model 412A or equivalent.

(2) Milliameter; range from 0 to 100 mA.

(3) Standard 3-conductor phone plug such as Switchcraft No. 290, or equivalent.

(4) 150Ω, 5%, 2W carbon composition resistor (see para. 1-12).

(5) Test oscilloscope with vertical frequency response of 1 MHz or greater; vertical sensitivity of 5 mV per division, or greater; calibrated time base.

(6) Coaxial 50Ω attenuator (10X); Tektronix type 011-0059-01 or equivalent; BNC connectors.

(7) RF signal generator tunable to 100 kHz and 300 kHz with calibrated output of 0.3 μV (or less) into 50Ω; Hewlett-Packard 606A or equivalent.

(8) Approximately 35 to 50 ft of unshielded cable or wire; AWG 26 or larger diameter, as convenient.

(9) Cardboard carton approximately 20" high and large enough to support the Model 500 receiver.

(10) Yardstick or tape measure.

(11) 5/64" Allen (hex) wrench.

(12) Frequency counter; 300 kHz.

1-12. Make a transmitter test load by connecting the 150Ω resistor (item 4 above) between the tip and the ring or sleeve of the phone plug (item 3 above). An alternate method is to connect the transmitter output cable to the load resistor.

NOTE

When testing performance or troubleshooting a transmitter, a properly operating receiver unit should be available; similarly, a properly operating transmitter should be available for use for receiver maintenance.

1-13. Troubleshooting

1-14. When troubleshooting the Model 500, the first step is to isolate the trouble to either the transmitter or the receiver. This is easily done by checking the transmitter output across an open load or a 150Ω load; use the procedure in para. 3-5. The next step is to check and, if necessary, replace the batteries in the malfunctioning unit. Then proceed to the appropriate section in this manual.

1-15. The Model 500 transmitter unit is closely related to a keyed CW low frequency transmitter, and relevant circuit features are discussed in Section II. Maintenance and troubleshooting procedures are likewise similar to those for a transmitter. Appropriate test point signal levels and dc voltages are indicated on the schematic diagram.

1-16. Likewise, the receiver unit operation and maintenance are similar to a single-sideband receiver, as described in Section IV. Again, appropriate test point voltages and signal levels are indicated on the schematic diagram.

1-17. In general, the easiest way to locate an inoperative stage is to check the various test points with a voltmeter and/or an oscilloscope. Always start with a power supply check and then, if necessary, follow the procedure in the troubleshooting tables to isolate trouble to a particular stage as indicated. Note that the troubleshooting tables are designed to isolate trouble to a particular stage; it is assumed that maintenance personnel will be familiar with test equipment and single-stage troubleshooting techniques.

SECTION II
TRANSMITTER CIRCUIT DESCRIPTION

2-1. GENERAL

2-2. The Model 500 Transmitter Assembly A1 generates a 300 kHz RF signal that is pulse-modulated at about 20 Hz. The transmitter output is designed to drive a wide variety of loads for convenient coupling to individual conductors or cables. Pulse modulation has two advantages: it makes the signal easy to identify, and it significantly extends battery life. Internal protection circuits limit the output signal for convenience in driving very low impedance loads; this enables the transmitter to be coupled to any conductor or cable without requiring any tuning adjustments. For open or high impedance loads, a high-Q output circuit provides a high output signal level without being hazardous.

2-3. The block diagram, Figure 2-1, shows the principal circuits in the transmitter unit. The signal source is a 300 kHz crystal oscillator; its output is buffered, and the buffer output is gated at 20 Hz to produce a pulse-modulated signal. The gated RF drives a 2-stage power amplifier that is coupled to the output by a resonant circuit. This circuit drives a loop antenna; however, the loop is disconnected when a cable is plugged into the output connector for use with a Dyna-Coupler™ (Dynatel No. 3001) or a direct cable connection.

2-4. The gating signal is generated by a 20 Hz astable multivibrator; the 20 Hz pulse drives a gate clamp that turns the gate control transistor on and off at 20 Hz. Note that the gate control transistor is also used in the feedback loop that limits the output signal when driving a low impedance output.

2-5. Oscillator

2-6. The crystal oscillator is formed by Q1 and Y1; Q1 is biased by R1 for an optimum output signal over a battery voltage range that can vary from 3.5 to 12 volts. The oscillator output is buffered by emitter follower Q2, which drives the gate transistor Q3 without loading the crystal oscillator.

2-7. Gate Circuit

2-8. The function of the gate transistor Q3 is to pulse-modulate the 300 kHz oscillator signal at a 20 Hz rate; this minimizes battery drain and provides a distinctive signal for easy identification. The gate is controlled by Q9; when Q9 is saturated, the gate transistor Q3 operates as an emitter follower. C4, R6 and R7, which are in the emitter circuit of Q3, are used to eliminate switching transients that would cause "key clicks" in the output signal.

2-9. Power Amplifier

2-10. The power amplifier is formed by a common emitter driver transistor Q4 and an emitter follower power amplifier Q5. During the interval when the 300 kHz RF is gated off, the bias network formed by CR1, R8 and R9 holds the driver Q4 slightly back-biased. Thus, when Q4 is off, Q5 is also off. During the interval when the RF is gated on, negative pulses passing thru C5 cause Q4 to operate as a class C amplifier. The collector current pulse remains constant even though the battery voltage can vary from 3.5 to 12V.

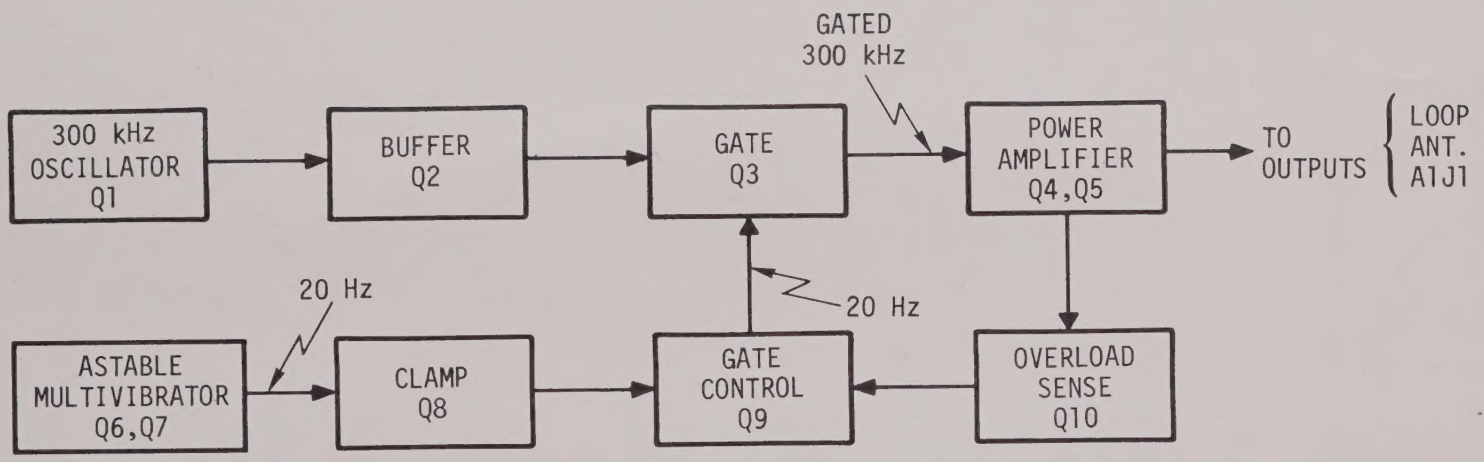


Figure 2-1. Transmitter Assembly A1 Functional Block Diagram

2-11. Similarly, Q5 is a class C power amplifier; its emitter drives a tapped inductor in the output tank circuit (L1, C11, C12). The high Q of the output tank circuit causes an emitter voltage swing that is approximately double that of the battery voltage. The output from the tank circuit is taken from the divider formed by C11 and C12. This signal goes to the output connector A1J1, which in turn connects the output to a tuned antenna circuit formed by A1A2L1 (which is mounted on the case) and the capacitors C8, C9, and C10. When a 3-conductor phone plug is connected to A1J1, the loop antenna is disconnected.

2-12. Gate Circuitry

2-13. The gate signal is generated by an emitter-coupled astable multivibrator formed by Q6 and Q7. The output from the collector Q7 drives the base of the clamp circuit Q8. The collector circuit Q8 is connected so that it shunts the base current of Q9 to ground when the clamp transistor is on. This turns Q9 off, which turns off Q3.

2-14. Overload Circuit

2-15. The base of the overload sense transistor Q10 is connected to the output tank circuit at R12. In the NORMAL operating mode, R12 and R13 are connected in series. When the impedance at the output of the transmitter is sufficiently low, there will be enough current thru R12 and R13 to turn Q10 on. The collector circuit of Q10 shunts the base drive current of Q9, which limits the collector resistance of Q9. This in turn limits the amplitude of the RF pulses, and reduces the output. If the transmitter load is less than 50Ω, the output current is sufficient to turn on Q10. Note that when the transmitter is used in the HIGH (power) mode, the junction of R12 and R13 is connected to ground by S1, which allows the output power to increase before limiting occurs.

2-16. Power Supply

2-17. The transmitter power supply consists of two 6V batteries, each of which is connected in series with a diode-connected transistor. This prevents shorting if the batteries are not connected properly.

2-18. In the normal operating mode, switch S1-1 connects the negative side of B2 to ground; S1-2 connects the positive side of B1 to the emitter of Q12. In this way, B1 and B2 are connected in parallel. A third section, switch S1-3 connects the batteries to the power supply bus in the transmitter circuit.

2-19. In the HIGH (power) mode, switch S1-2 connects the positive terminal of B1 directly to the negative terminal of B2, and Q12 is switched out of the circuit. This doubles the power supply voltage available at the collector of Q11, which is again switched to the power supply bus by S1-3. Section S1-1 grounds R13, which permits Q5 to conduct more before the overload circuit begins to limit the output. Thus, the higher supply voltage enables the output amplifier Q4 and Q5 to deliver more power to the output.

2-20. For the battery test, switch S1-2 connects B1 in series with B2, and Q12 is switched out of the circuit. The output of the batteries at the collector Q11 then goes to the battery test circuit, which is composed of the load transistors R14 and R15, and the battery test indicator lamp I-1. During battery test, CR2 is forward-biased so that there is approximately 12V on the power supply bus. The battery test indicator operates at 3V, so it will turn on if the battery voltage is sufficient. Diodes CR3 and CR4, which are in series with the parallel combination of R14 and R15, provide sufficient voltage drop so that I-1 is nearly out when the battery voltage has dropped to approximately 9V. Note that

the transmitter will still operate at reduced power when battery voltage is as low as 4V. When the batteries are fresh (12V), I-1 operates at its rated voltage.

2-21. During the battery test, the battery is connected to the transmitter power supply bus by CR2; this allows the transmitter to operate, and increases battery drain during the battery test. Note, however, that the clamp transistor Q8 is biased to cut-off during the battery test, so that the gate transistor Q3 remains on for the duration of the test. The CW output increases the battery load even further; during the battery test the transmitter draws four times more current than it does during HIGH power mode operation.

2-22. Note that the CW transmitter operation during the battery test can be useful for checking the RF output with a counter or an oscilloscope.

SECTION III

TRANSMITTER MAINTENANCE

3-1. DISASSEMBLY PROCEDURE

3-2. Circuit Board Removal

3-3. For access to the batteries, printed circuit board unit and antenna assemblies, use the following procedure:

(1) Remove the receiver from the transmitter/carrying case unit for access to the four screws that secure the storage tray in the transmitter carrying case. Release the screws and lift the storage tray up out of the transmitter case.

(2) Remove the three Phillips screws that secure the transmitter panel assembly to the carrying case.

(3) Remove the hex nut that secures the phone jack to the side of the carrying case.

(4) Slide the transmitter panel assembly to one side for access to the phone jack and the antenna assembly. Then pull the phone jack free from the mounting hole in the carrying case.

(5) Disconnect the antenna wires.

(6) The transmitter panel assembly, printed circuit board assembly, and the transmitter batteries are now free, and can be lifted from the carrying case.

(7) Remove the knob on the transmitter OUTPUT selector; use the 5/64" Allen wrench.

(8) Remove the hex retaining nut on the transmitter OUTPUT selector.

(9) Remove the hex nut that secures the cable clamp on the PC assembly. It should now be possible to remove the printed circuit board from the panel assembly.

3-4. Reassembly Procedure

3-5. To replace the printed circuit assembly, reverse the disassembly procedure. If the loop antenna assembly has been removed, it should be secured with contact cement to adhere well to the fiberglass case.

3-6. TRANSMITTER PERFORMANCE TEST

3-7. Use the following procedure to check the transmitter output frequency, output power, and pulse modulation.

(1) Connect the 150Ω test load to the transmitter output connector A1J1. It is also possible to use the transmitter output cable with the 150Ω load connected between the red and black clips (black is chassis common).

(2) Connect the oscilloscope vertical channel across the 150Ω load. Set the oscilloscope vertical and horizontal channel controls to monitor a 30V peak-to-peak signal that is pulse-modulated at 20 Hz. 50%

(3) Turn the transmitter OUTPUT selector to HIGH.

(4) Measure the output voltage across the 150Ω load with the oscilloscope. With fresh batteries, the output voltage should be 30V peak-to-peak, or greater; in NORMAL mode, the output should be 10 to 12V peak-to-peak. The pulse modulation rate should be approximately 20 Hz, but is not critical.

NOTE

Be sure to use fresh batteries when checking the transmitter output signal level.

(5) If desired, the 300 kHz carrier frequency can be checked as outlined above with the oscilloscope or a frequency counter. To check the transmitter carrier frequency on a CW signal, turn the transmitter OUTPUT selector to the BAT position and hold it for the duration of the test. Keep the test as short as possible since the battery load is four times greater than normal in the battery test load.

CAUTION

The transmitter power is sufficient to damage the input of a sensitive counter. Be sure to use an attenuator or divider network; for example: a 100:1 divider formed by a 1000Ω and a 10Ω resistor.

The transmitter carrier frequency should be 300 kHz ±50 Hz; this is not critical as long as the receiver sensitivity is adequate. Consequently, the following procedure is a more practical way to check the transmitter carrier frequency.

(a) Turn the transmitter OUTPUT selector to NORMAL.

(b) Turn the receiver MODE SELECTOR to PEAK, and bring the receiver near the transmitter; listen for a pulsed audio tone. It may be necessary to move the receiver closer to the transmitter and/or increase the receiver gain somewhat until a tone is heard. A pulsed audio tone of 400 to 600 Hz indicates that the transmitter carrier frequency is correct. This concludes the transmitter performance test.

3-8. TRANSMITTER ADJUSTMENT AND ALIGNMENT

(1) Remove the transmitter printed circuit assembly as indicated in the disassembly procedure for access to A1J2. The transmitter can be operated outside the carrying case.

(2) With a soldering iron, disconnect the jumper wire between A1J2 pins 9 and 10.

(3) Connect the positive terminal of a 100 mA milliammeter to pin 9; connect the negative lead to pin 10.

(4) Disconnect the loop assembly A1A2 by plugging the transmitter cable into A1J1; make sure the cable clips are open-circuited to keep from loading the transmitter output.

(5) Turn the transmitter OUTPUT selector to NORMAL.

(6) Remove the protective cover on L1 for access to the trimming screw. Use a noninductive adjustment tool and adjust L1 for the minimum current indicated on the milliammeter; typically the current will be 5 to 10 mA.

(7) Set the transmitter OUTPUT selector to HIGH.

(8) With the noninductive adjustment tool, adjust the inductance of L1 for minimum current on the milliammeter. Typically this current will be 18 to 25 mA.

(9) Turn the adjustment screw on L1 counterclockwise for an increase of 2 mA, as indicated on the milliammeter.

(10) Turn the transmitter OUTPUT selector to HIGH and remove the cable and/or load assembly from the transmitter output A1J1.

(11) Adjust A1A1C9 (the mica trimming capacitor for the transmitter loop antenna) for the maximum current as indicated on the milliammeter. Typically this current will be 40 to 50 mA.

NOTE

To avoid incorrect tuning, be sure the transmitter loop is at least 12" from any large metal objects.

(12) Turn the transmitter OUTPUT selector to OFF.

(13) Disconnect the meter from pins 9 and 10 of connector A1J2, and reconnect the jumper wire.

(14) This concludes the transmitter alignment and adjustment procedure. Reassemble the transmitter unit.

3-9. TROUBLESHOOTING

3-10. If a malfunction is isolated to the transmitter, the first step is to check and replace the batteries if necessary. Assuming the batteries are fresh, there are several possible faults that can be resolved by checking test points, as indicated in the schematic diagram. The procedure in Table 3-1 can also be used as a guide to resolving symptoms.

NOTE

When checking test points indicated on the schematic, voltages in parentheses — for example, (5.6) — indicate that OUTPUT switch is in NORMAL mode. Other voltages indicate that OUTPUT switch is in HIGH mode.

Table 3-1. Transmitter Troubleshooting

Symptom	Test Procedure	Possible Malfunction
Low output or no output.	Check power supply bus.	Q11 and/or Q12 open; switch defective; also check connector A1J2 and associated wiring, including battery connections (red wires go to positive [+] terminals).
	Check signal at TP4.	
	For low signal or no signal:	(1) Q9 open or biased off. Q9 must be near saturation for maximum output. Check Q9 bias control circuit, including Q8 and Q10. Ground base of Q8, then Q10 to isolate

Table 3-1 (Cont)

Symptom	Test Procedure	Possible Malfunction
		malfunction to multivibrator or overload circuit.
		(2) Q3 malfunction; check Q3, C4 and emitter resistors.
		(3) Q2 malfunction; check Q2 and associated components.
		(4) Q1 or Y1 malfunction; check voltages at TP1 and TP2. Check for 300 kHz at Q2 emitter with oscilloscope.
	Signal OK:	(1) Output amplifier malfunction; check test points TP10, 11, 12 and 16.
		(2) Antenna or tank circuit out of adjustment. Follow adjustment procedures.
	Check for correct oscillator frequency; use counter at TP3; FREQUENCY incorrect.	Y1 malfunction. Check C1, C3; also check for defective crystal by replacement.
No 20 Hz pulse.	Check waveshape at TP7; no signal.	Short to ground at base of Q8. Multivibrator malfunction (Q6,7); check for signals at TP5 and 6; also check voltages.
	Check signal at TP9.	
	Signal OK:	Q9 or associated bias circuit defective.
	No signal:	Q10 shorted or saturated. Ground Q10 base and recheck.
Abnormal battery drain.	Check CR2.	CR2 shorted.
	Check Q4 bias.	Ground Q9 base; Q4 and Q5 should not draw current.
	Check Q11 and Q12.	Q11 or Q12 open.
	Check filter capacitors.	Leaky capacitor.
	Check L1, C11, C12	L1 detuned, see para. 3-7.

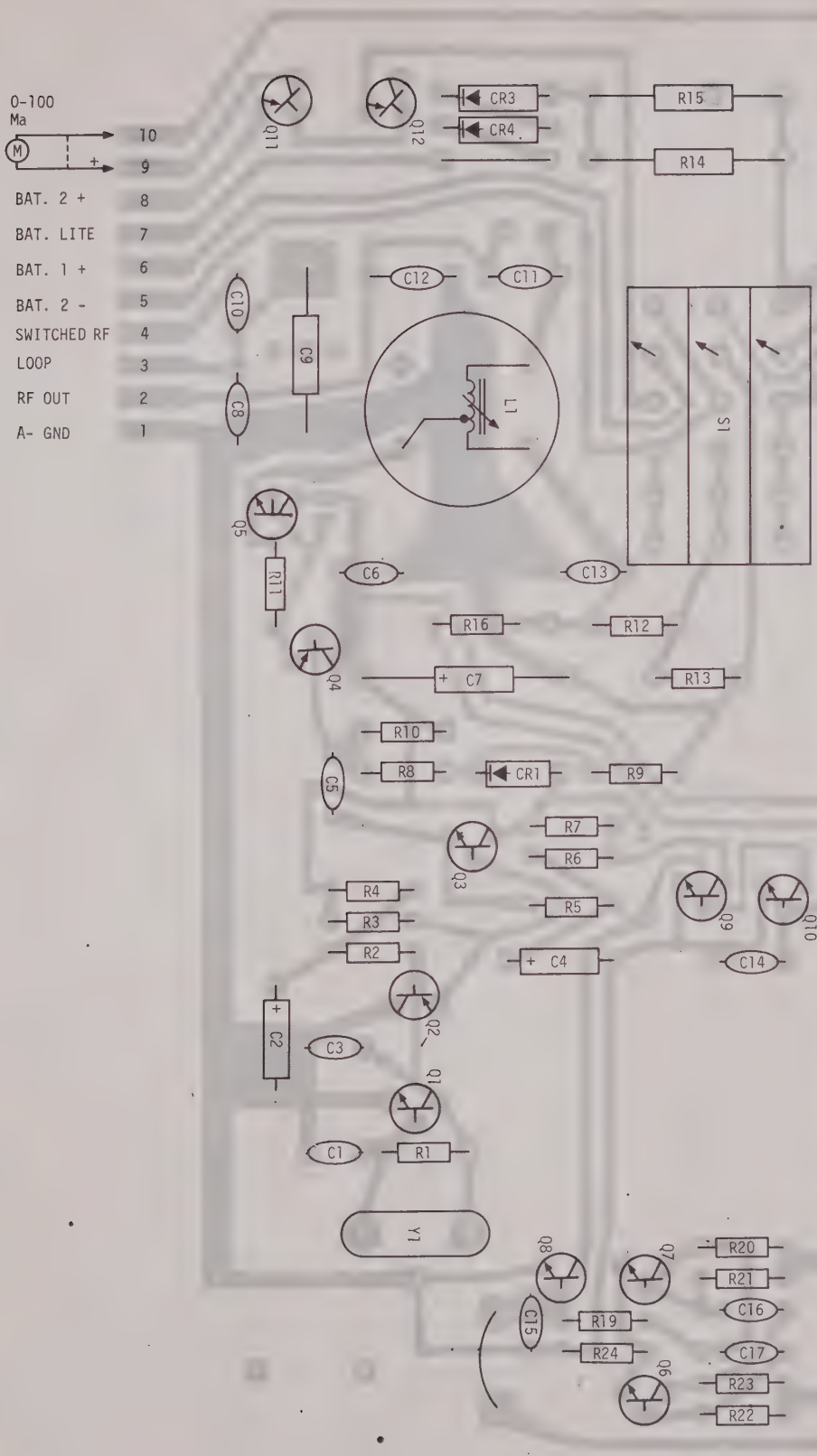


Figure 3-1. Transmitter Circuit Assembly A1A1 Assembly Diagram

TABLE 3-2. PARTS LIST, TRANSMITTER ASSEMBLY A1*

Circuit Ref.	Description	Dynatel Part No.	Manufacturer	Manufacturer's Part No.
A1A1	Transmitter PC Assy	9010-0022	Dynatel	
C1	22 pF ±5%	2025-2225	Cornell-Dubilier	DM-15
C2	2.2, 20V electrolytic	2551-1226	Dickson	CS13BE225K
C3	220 pF, ±5%	2025-3225	Cornell-Dubilier	DM-15
C4	2.2, 20V electrolytic	2551-1226	Dickson	CS13BE225K
C5	.01 ±10%	2033-5106	Stettner-Trush	MKT-1819
C6	.22 ±20%	2033-6227	Stettner-Trush	MKT-1820
C7	100, 25V electrolytic	2501-3109	Siemens	B41283
C8	1500 pF ±5%	2025-4155	Cornell-Dubilier	DM-19
C9	50-350 pF	2703-3359	ARCO	428
C10	220 pF ±5%	2025-3225	Cornell-Dubilier	DM-15
C11	1000 pF ±5%	2025-4105	Cornell-Dubilier	DM-15
C12	6800 pF ±10%	2035-4686	Stettner-Trush	KC 1807
C13	.47 ±20%	2032-6477	Stettner-Trush	MKT-1819
C14	.01 ±10%	2033-5106	Stettner-Trush	MKT-1819
C15	470 pF	2017-3476	Centralab	DD-471
C16	.047 ±10%	2034-5476	Stettner-Trush	MKT-1822
C17	.047 ±10%	2034-5476	Stettner-Trush	MKT-1822
CR1 thru CR4	1N4005	1200-0003	General Inst.	1N4005
L1	Inductor	9030-0001	Dynatel	9030-0001
Q1	2N3565	1400-0002	Fairchild	2N3565
Q2	2N4919	1401-0001	Fairchild	2N4917
Q3	2N3565	1400-0002	Fairchild	2N3565
Q4	2N4917	1401-0001	Fairchild	2N4917
Q5	MPS-U01	1402-0005	Motorola	MPS-U01
Q6 thru Q10	2N3565	1400-0002	Fairchild	2N3565
Q11, Q12	2N508 or 2N396	1301-0001	Teledyne	2N508/2N396
*R1	1M ±5%	3013-7105	Roederstein	SK-2
R2	22K ±5%	3013-5225	Roederstein	SK-2
R3	15K ±5%	3013-5155	Roederstein	SK-2
R4	2200 ±5%	3013-4225	Roederstein	SK-2
R5	1000 ±5%	3013-4105	Roederstein	SK-2
R6	220 ±5%	3013-3225	Roederstein	SK-2
R7	18K ±5%	3013-5185	Roederstein	SK-2
R8 thru R10	33K ±5%	3013-5335	Roederstein	SK-2
R11	680 ±5%	3013-3685	Roederstein	SK-2
R12	2.7 ±5%	3053-1275	Allen Bradley	RL104
R13	15 ±5%	3013-2155	Roederstein	SK-2
R14, R15	47, 2W ±10%	3055-2476	Allen Bradley	RL104
R16	470 ±5%	3013-3475	Roederstein	SK-2
R17	33K ±5%	3013-5335	Roederstein	SK-2
R19, R20	15K ±5%	3013-5155	Roederstein	SK-2
R21, R22	1M ±5%	3013-7105	Roederstein	SK-2
R23	15K	3013-5155	Roederstein	SK-2
R24	220 ±5%	3013-3225	Roederstein	SK-2
S1	Switch Assembly	5500-9016	CTS	5500-9016
Y1	Crystal, 300.000 kHz	5410-0001	Bulova	CR46-A/u

* Unless otherwise specified, all capacitors in μF; all resistors in Ω, 1/4W, 5% carbon composition.

TABLE 3-2 (Cont)

Circuit Ref.	Description	Dynatel Part No.	Manufacturer	Manufacturer's Part No.
A1A2	Antenna Assembly	9080-0041	Dynatel	9080-0041
L1	Antenna Loop			
A1A3	Dyna-coupler™	3001	Dynatel	3001
A1B1, B2	Batteries, 6V	5100-0004	Burgess	Neda 915, or equiv.
A1I1	Indicator;	1910-0001	Sylvania	#45
	Holder	5550-1000	Littelfuse	930-404X
A1J1	3-conductor phone jack	5200-1010	Switchcraft	23C
A1J2	10-pin edge-type P.C. connector	5200-0110	Elco	00-6007-010-940-002
A1P1	Phono plug	5200-1008 P/o A1W1	Molex	A2181
A1W1	Cable Harness Assy	5940-9005	Dynatel	
A2W2	Coupler Cable Assy	5941-9011	Dynatel	
A2W3	Output Cable Assy	5941-9012	Dynatel	

10-85

KNOB, VOLUME CONTROL 78-8029-1404-6 ↑2.92

KNOB, RECEIVE MODE 26-1003-2983-3 ↑2.19

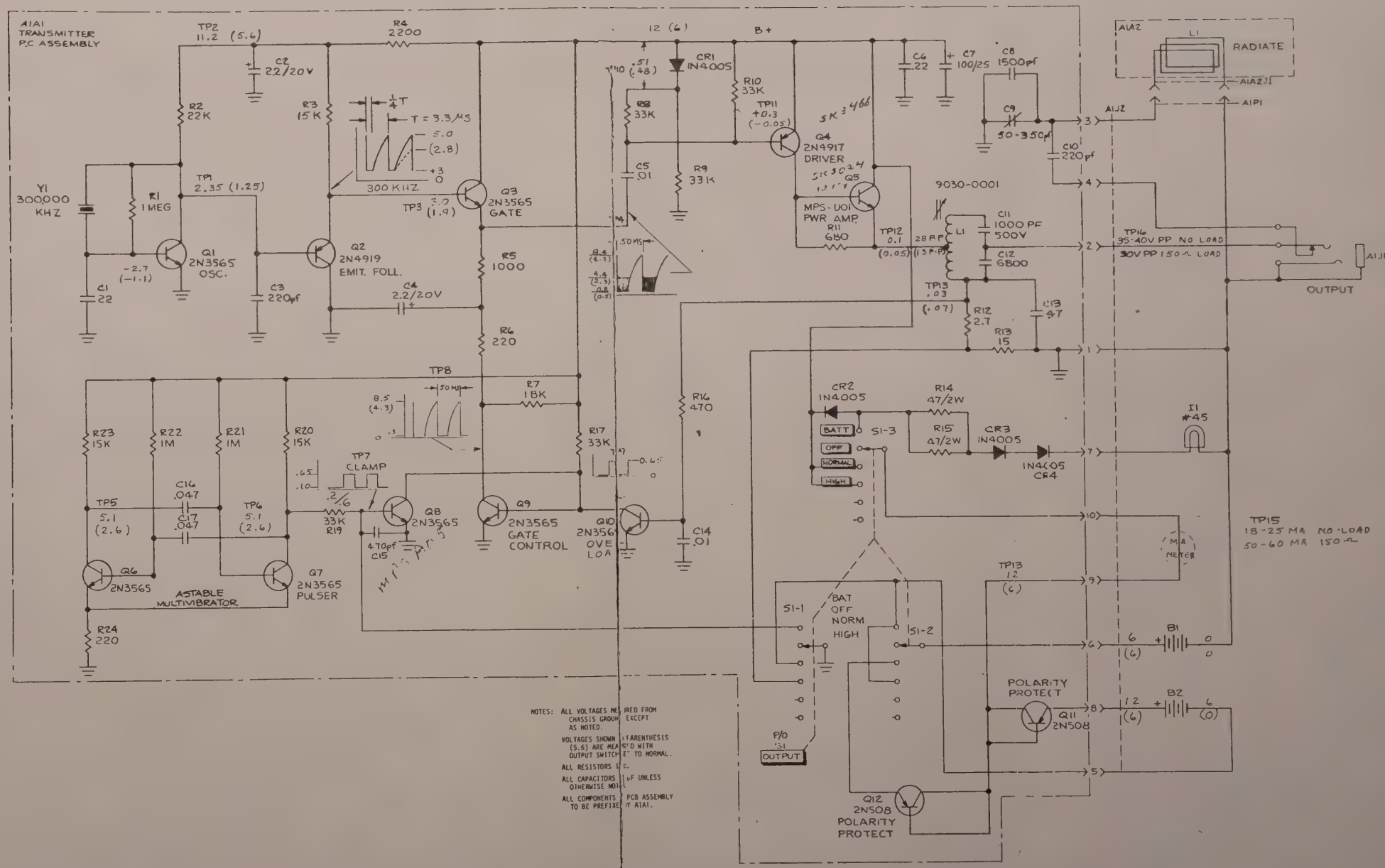


Figure 3-2. Transmitter Schematic Diagram

SECTION IV
RECEIVER CIRCUIT DESCRIPTION

4-1. GENERAL

4-2. The Receiver Unit is essentially a tuned radio frequency single sideband superheterodyne receiver unit that is designed to receive and demodulate the 300 kHz RF carrier signal that is generated by the Model 500 Transmitter Unit. The receiver is designed so that the only audio output is a nominal 549 Hz signal. The receiver also has a level meter that indicates the relative strength of the transmitter carrier being received. The major functional circuit blocks of the Receiver Unit are shown in Figure 4-1.

4-3. The Receiver Unit has two major assemblies: an antenna circuit assembly A2A1, which has two self-contained antennas, and a receiver circuit assembly A2A2. The antenna circuit assembly contains a loop antenna that is used when the receiver is in NULL mode. In this mode, when the loop is directly over a cable, the signal output from the loop antenna is minimum, and consequently both the audio output and the meter indication are likewise minimum. The second antenna is a ferrite-core loop antenna that is used in the PEAK and SET modes. The ferrite antenna picks up the maximum signal when the receiver is passed over a conductor with 300 kHz tone, provided that the receiver handle is parallel to the conductor.

4-4. The input to the receiver circuit assembly is selected by the receiver mode switch; in addition to the two antennas, there is a provision for an external signal input from the EXT jack.

4-5. Receiver Circuit Assembly

4-6. The input selected by the RECEIVER MODE switch goes to T1, which is tuned to 300 kHz. The output of T1 goes to a capacitive divider that is used for impedance matching. The divider output goes to one section of the gain control R1. The output of R1 at the center arm goes to another section of the RECEIVER MODE selector; note that in the SET mode the signal is attenuated by resistors R2 thru R4. These resistors are factory-selected for correct depth measurements.

4-7. The RECEIVER MODE switch connects the selected input signal to the RF amplifier Q1 and Q2. Q1 is an emitter follower for temperature and impedance matching, and Q2 is a common emitter amplifier that provides low-level RF gain. The output of Q2 goes to T2, which is a tuned RF transformer. The output of T2 goes to the mixer input.

4-8. The other input to the mixer is the output of the crystal-controlled local oscillator Q3. Crystal Y1 holds the oscillator signal at 200,183 Hz. The output from the emitter of Q3 goes to the output of T2, and both signals go to the mixer at U1 pin 2.

4-9. The mixer circuit is part of the integrated circuit U1. The output at U1 pin 3 goes to T2, which is a 100 kHz IF transformer. The mixer is a highly nonlinear circuit, so that it mixes the RF and the local oscillator signals, plus the oscillator second harmonic. Because fundamental is mixed with the second harmonic, the mixer output contains two

signals of interest that are near 100 kHz; the first is 99,817 Hz, and the second is 100,366 Hz. IF transformer T3 passes these two signals, and attenuates the other mixer outputs. The output of T3 is further attenuated by the second section of the gain control R1 and then amplified by another section of U1 (at pin 4).

4-10. The output from the IF amplifier goes to a second IF transformer T4, which further attenuates all other signals except the two signals at 100,366 and 99,817 Hz, respectively.

4-11. The output of T4 goes to a product detector, which mixes the two output signals from T4. The primary output of the product detector is a nominal 549 Hz audio signal. This signal then goes to a high pass active filter (Q4) and a low pass active filter (Q5). The high and low pass filter sections form a bandpass filter with the 3 dB points at 500 Hz and 600 Hz, which passes the 549 Hz audio signal. The output from the emitter of Q5 then goes to a common emitter audio amplifier circuit, Q6. The 549 Hz audio output from Q6 then goes to yet another section of the integrated circuit U1 at pin 14 for further amplification.

4-12. The output from U1 at pin 15 goes to the audio power amplifier U2. The output from U2 at pin 2 goes to the speaker.

4-13. Power Supplies

4-14. The Model 500 Receiver has two similar current-regulating/limiting power supplies. One, formed by Q8 and Q9, regulates the current to the RF and low-level audio stages; the second (formed by Q9 and Q10) limits the current to the audio power amplifier. Separate power supplies provide stable voltages to the low-level stages and a current-limited voltage to the class B power amplifier stage.

4-15. Operation of the current regulator circuits are similar, so only the low-level supply is described. All power is supplied by two parallel 9V batteries, B1 and B2. The positive terminal of each battery is connected to the emitter of a diode-connected PNP transistor (Q13 and Q14) which serves as low-voltage-drop polarity-protection diode. The collectors of both Q13 and Q14 are connected in parallel to the center arm of one section of the receiver mode switch S1. Except for the battery test, all other switch positions on S1 are tied to the inputs of both current regulators.

4-16. In the low-level current regulator, power is supplied to the emitter of Q7 thru a 100Ω resistor. Q7 acts as a controlled current source; its bias, and hence its collector current, is determined by the series combination of R31 and R32. Q8 is a current-limiting switch; it is normally off unless the current thru R33 exceeds 6.7 mA for battery voltages between 6V and 9V. If the current requirements exceed 6.7 mA, the voltage across R33 will turn Q8 on, which limits the base drive current for Q7 and reduces the collector current to the design level.

4-17. Signal Strength Meter Circuit

4-18. The signal strength meter circuit provides a relative indication of the signal level being received. Note the increased sensitivity of the center section; a 1 dB level change causes the meter deflection to change from approximately 20% to 80% of full scale.

4-19. The metering circuit takes advantage of the fact that the audio output signal (from U2) is proportional to the emitter current of Q9; consequently, the metering circuit monitors the current thru R43. The metering circuit consists of Q11 and Q12. Q11 is an emitter follower that provides a base-emitter voltage drop to compensate for temperature effects on the operating point of Q12.

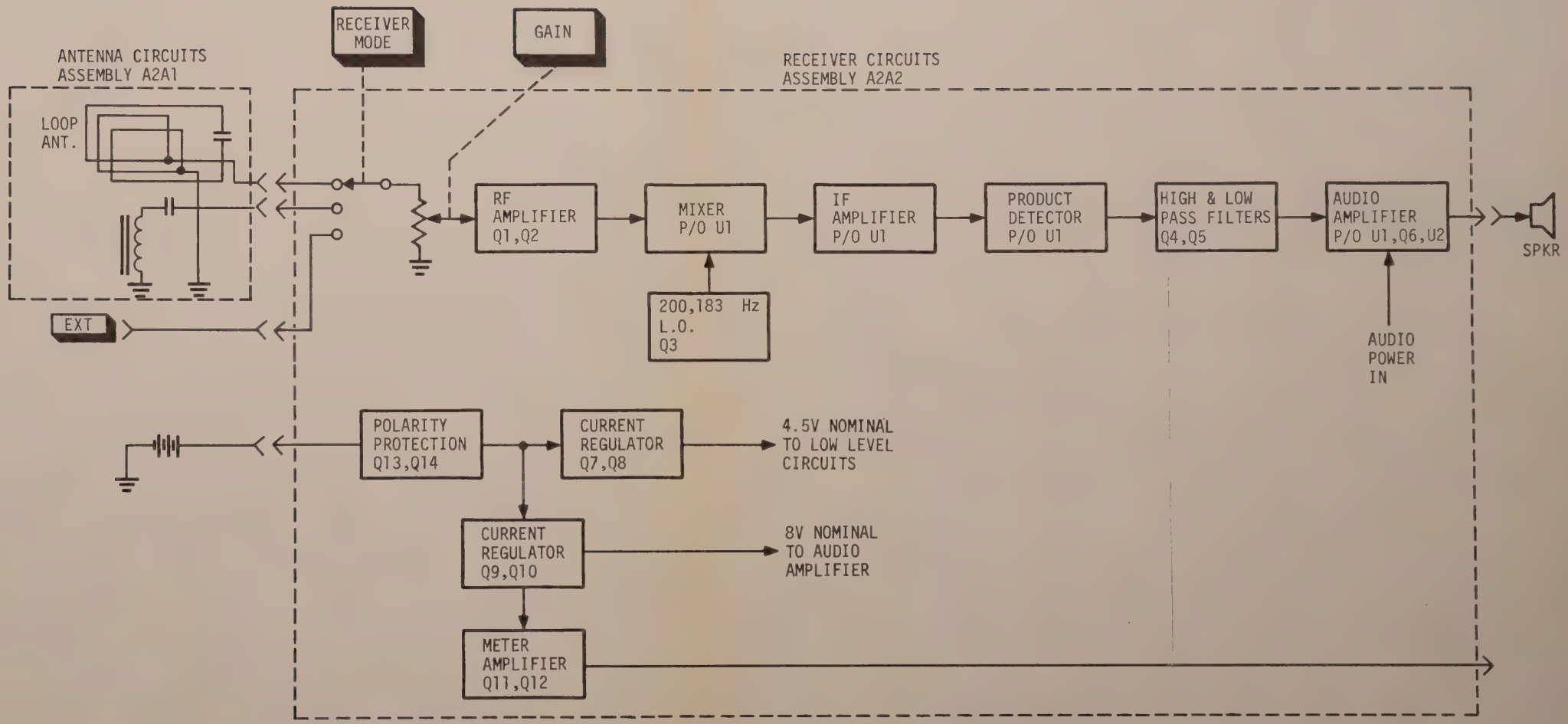


Figure 4-1. Receiver Block Diagram

The meter amplifier Q12 provides drive current for the level meter M1 that changes with the emitter voltage of Q11, and hence, the current thru R43.

4-20. For battery testing, the RECEIVER MODE selector is set so that the entire battery voltage is placed across R42; this provides a load on the batteries that is similar to the operating load of the receiver. R41 calibrates the current thru meter M1 during the battery test. CR1 and CR2 provide current steering.

SECTION V
RECEIVER MAINTENANCE

5-1. DISASSEMBLY PROCEDURE

5-2. Batteries

5-3. For access to the battery compartment, refer to the Operating Instruction Manual.

5-4. Circuit Board Removal

5-5. For access to the printed circuit board unit and the antenna assemblies, use the following procedure:

(1) Turn the Receiver Unit upside down.

(2) Remove the four Phillips screws near the corners of the receiver, and lift off the bottom cover of the receiver. Unplug the antenna connectors.

(3) To remove the main printed circuit board assembly (A2A2) from the receiver chassis, first remove the Gain control and the RECEIVER MODE control knobs with a hex (Allen) wrench; note that each knob has two setscrews.

(4) Remove the three screws that secure the printed circuit board assembly to the receiver chassis. At this point the printed circuit assembly can be lifted out of the receiver chassis assembly. Disconnect the circuit assembly from the printed circuit connector A2J3.

(5) For access to the IF strip, remove the shield by melting the solder at each end of the shield.

5-6. REASSEMBLY PROCEDURE

5-7. To replace the receiver circuit board assembly, reverse the above procedure.

5-8. When replacing the bottom cover of the Receiver Unit, turn the cover so that the antenna assembly is away from the main printed circuit board assembly; the unit will not fit together properly otherwise.

5-9. RECEIVER PERFORMANCE TEST

5-10. Use the following procedure to check the receiver sensitivity, NULL mode cable location accuracy, and the cable depth location accuracy (SET) mode.

5-11. Receiver Sensitivity

(1) Connect the RF output of signal generator to a 50Ω, X10 attenuator pad head; then connect the attenuator output to the external (EXT) input A2J1 of the receiver. Use a 3-conductor phone plug.

(2) Set the signal generator as follows:

Modulation mode: CW
Signal attenuation: Maximum (minimum signal output)
Output frequency: 300 kHz ±50 Hz

(3) Set the Model 500 Receiver controls as follows:

Gain Control Knob: fully clockwise (maximum)
RECEIVER MODE Selector: EXT

NOTE

If coupling to the signal generator produces excessive hum and noise pickup, both the signal generator and the Model 500 circuit should be grounded. Use the sleeve conductor of the EXT input jack. If a metal bench is being used, it may be necessary to ground the bench also.

(4) Gradually increase the signal generator output level until the needle on the receiver panel meter moves to the middle of the scale (SET zone). Adjust the signal generator frequency for the maximum reading on the receiver meter (corresponding to a tone of 400-600 Hz); then readjust the receiver input signal level as necessary.

(5) The signal generator output level should be .30 to .35 μV for a mid-scale reading on the receiver meter (3.0 to 3.5 μV at the generator output).

(6) Disconnect the signal generator from A2J1.

5-12. Null, Peak and Depth Checks

(1) Generate a signal with the Model 500 Transmitter as follows:

(a) Connect 35 to 50 ft of a single-conductor cable (AWG 26 or greater) to the transmitter output.

(b) Connect the conductor to the transmitter output with the transmitter output cable. Use the red clip; do not connect the black clip (for convenience, it can be clipped back on the output cable). Set the transmitter case on the ground and then stretch the conductor out along the ground directly away from the transmitter.

NOTE

Conducting material affects the accuracy of the test. Conduct the test clear of machinery, buried pipes, reinforced walls, etc. For best results the test should be conducted outside.

(c) Finally, set the Model 500 Transmitter OUTPUT switch to NORMAL.

(2) Turn the RECEIVER MODE selector to NULL.

(3) Carry the receiver to an area near the center of the transmitter antenna conductor.

(4) Set the receiver Gain control to any convenient position such that the meter needle indicates in the middle two-thirds of the scale.

(5) Hold the receiver level and move it over the cable until a position is reached where the receiver meter indication and the loudspeaker output are minimum. Adjust the receiver gain as required for a sharp null.

(6) When the receiver is held level at a height of about two feet, the receiver should be within one inch of being centered over the conductor.

(7) Place a cardboard carton (approximately 20" high) over the center

area of the radiating conductor. Then set the receiver on the box directly over the conductor so that the handle is parallel to the conductor.

(8) Turn the RECEIVER MODE selector to SET and adjust the receiver Gain control so that the meter needle is within the SET area in the center of the scale.

(9) Turn the RECEIVER MODE selector to PEAK.

(10) Lift the receiver straight up until the meter needle returns to the SET area in the center of the scale. The distance from the top of the box to the bottom of the receiver should equal the height of the box plus or minus one inch.

5-13. ADJUSTMENTS

5-14. The Model 500 Receiver is designed to operate indefinitely with no periodic maintenance except for battery changes. In particular, no periodic adjustments are required; the adjustment procedures should be used only if a component has been replaced, or if the test procedure indicates a substantial performance deterioration.

NOTE

Before adjusting, be sure to check the receiver batteries; replace if necessary.

5-15. Antenna Circuit Adjustments

NOTE

Do not follow the adjustment procedure unless either the antenna or the receiver circuit board has been replaced. If an antenna circuit component has been replaced, adjust only the corresponding trimmer capacitor. Do not adjust the antenna circuits if a component was replaced on the receiver printed circuit board.

(1) Remove the receiver bottom cover.

(2) Set up a transmitter and antenna wire as described in para. 5-12, step (1).

(3) Turn the transmitter OUTPUT selector to NORMAL.

(4) Place the receiver bottom panel assembly on a platform or cardboard carton such that the antenna assembly is level and the long dimension is parallel to the transmitter antenna wire. Place the top portion of the receiver so that the two trimmer capacitors on the antenna assembly are accessible.

(5) Set the RECEIVER MODE selector to PEAK, and adjust the Gain control so that the meter needle is below mid-scale in the SET zone.

(6) Adjust the trimmer capacitor A2A1C4 for a peak signal level as indicated on the panel meter. See Figure 5-1. If the meter needle goes past the SET zone, the receiver gain should be reduced.

(7) Set the RECEIVER MODE selector to NULL and then move the receiver antenna assembly away to one side of the antenna wire so that there is an audible tone.

(8) Set the Gain control for less than mid-scale reading on the panel meter.

(9) Adjust trimmer capacitor A2A1C3 for maximum signal output level, as indicated on the panel meter. If the meter needle goes past the SET zone the receiver gain should be reduced appropriately.

(10) This concludes the antenna adjustment procedure. If no other adjustments are to be made, reassemble the receiver.

5-16. Receiver Circuit Adjustments

(1) Remove the receiver bottom cover and disconnect the antenna assembly.

(2) Connect an RF signal generator (thru a X10 attenuator) to the EXT input (A2J1) as described in para. 5-11, step 1. Set the receiver Gain control to maximum (fully clockwise).

(3) Adjust the signal generator frequency to about 300 kHz, for maximum meter reading (for an audible tone of 400 to 600 Hz). Then set the signal generator output level so the receiver meter needle points below the SET zone.

(4) Adjust transformers carefully for maximum gain in the following sequence: T4, T3, T2 and T1. Reduce the signal generator output level as required to keep meter reading below the SET zone.

NOTE

Transformers T4 and T3 are detuned slightly to provide optimum receiver performance at temperature extremes. The following steps outline this procedure.

(5) With all transformers carefully peaked, receiver sensitivity will be better than .30 µV (3.0 µV into the X10 attenuator). The receiver meter will read in the SET zone.

(6) Increase the signal generator output to 3.5 µV into the X10 attenuator.

(7) First detune (counterclockwise) T4, and then detune T3 — in equal amounts — until the receiver meter needle is within the SET zone (with maximum receiver gain).

(8) This concludes the receiver adjustments. Turn the receiver to OFF and reassemble it.

5-17. TROUBLESHOOTING

5-18. General

5-19. In general, the easiest way to locate an inoperative stage is to inject noise in various places in the receiver. For example, it is fairly easy to determine if the malfunction is in the audio section by injecting noise at the base of Q4. To do so, hold a metallic object and touch it against the junction of R16 and R18 at the base of Q4. Noise or hum from the loudspeaker — or a panel meter deflection — indicate that the audio section works, and the trouble is in the RF/IF section. However, if there is no output indication, the malfunction is in the audio section. Note that the easiest way to inject noise is to touch the appropriate point with a small, sharp metallic object such as an awl or a small knife (e.g., an X-ACTO brand knife with No. 11 blade). Be sure that the point makes good contact — thru the paint — at the test point.

CAUTION

Be careful not to short-circuit the test point to any other circuit component.

5-20. Trouble can be isolated to an individual stage by using the procedures in the following tables. Start with a power supply check in Table 5-1, and follow the procedure to the various other tables as indicated. In most instances, trouble can be isolated to a single active component — particularly in the RF/IF stages — by checking dc voltages in individual circuits.

5-21. Note that the following flow charts are organized on a basis of symptoms that would normally occur during a performance test or normal operation. The primary symptoms are as follows:

(1) Inaccurate NULL mode operation or depth measurement: check receiver performance according to para.5-12.

If performance is not correct, contact the factory for symptom analysis and/or return authorization.

(2) Low sensitivity or no output: see Table 5-1.
(3) Audio output but no meter reading: see Table 5-4.

Table 5-1. Receiver Troubleshooting

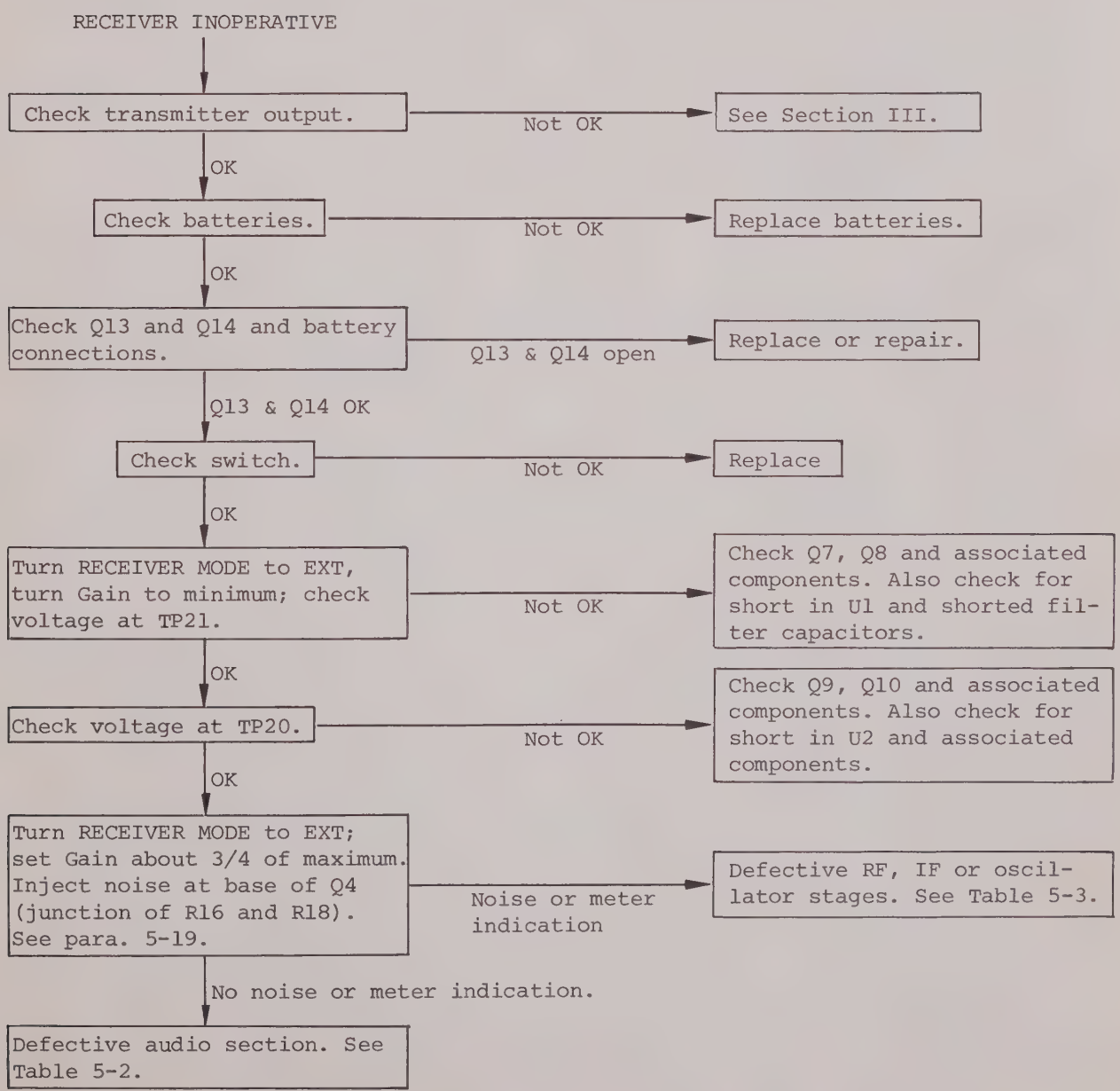
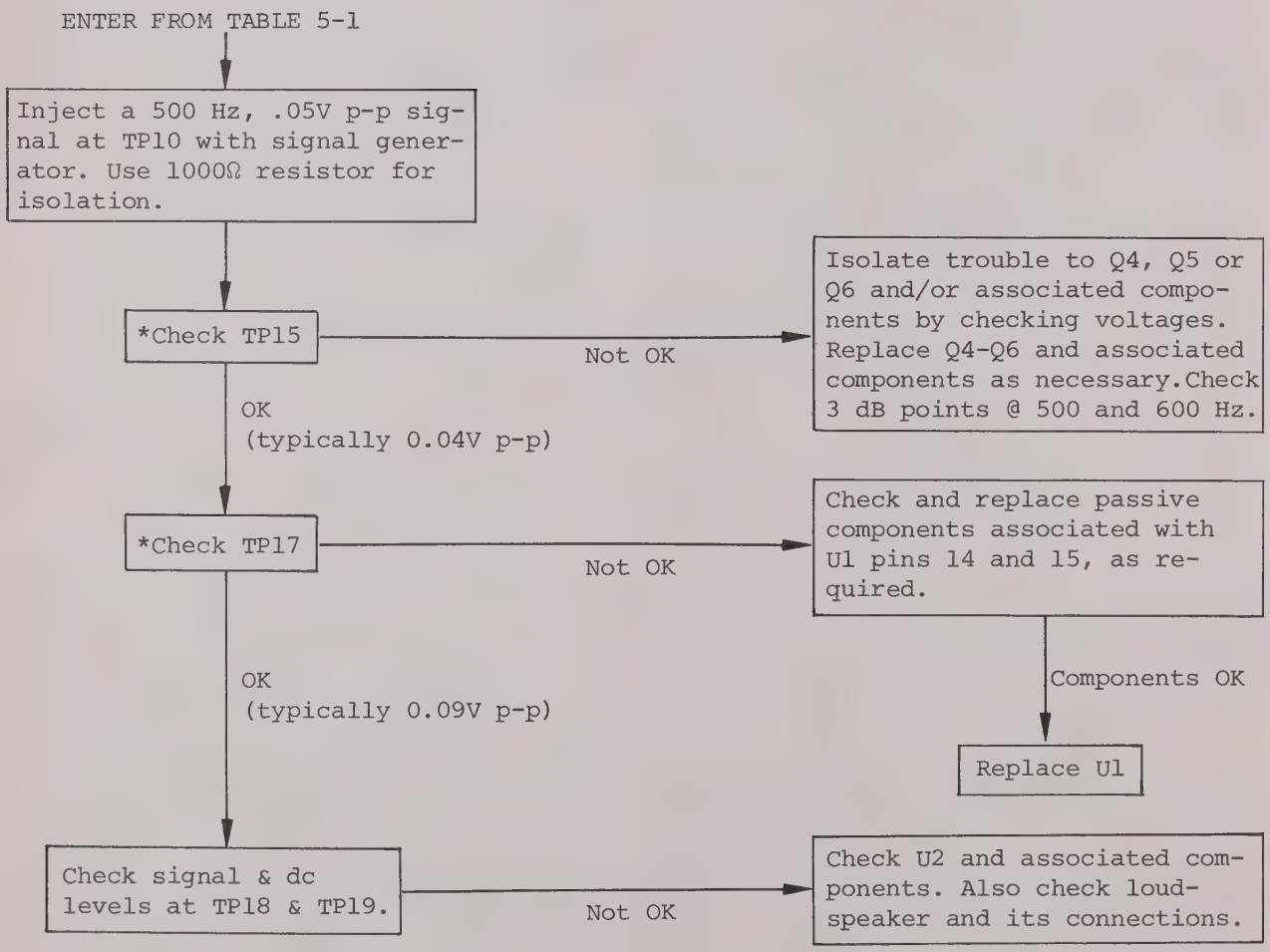

RECEIVER INOPERATIVE
Check transmitter output.
Not OK
See Section III.
OK
Check batteries.
Not OK
Replace batteries.
OK
Check Q13 and Q14 and battery connections.
Q13 & Q14 open
Replace or repair.
Q13 & Q14 OK
Check switch.
Not OK
Replace
OK
Turn RECEIVER MODE to EXT, turn Gain to minimum; check voltage at TP21.
Not OK
Check Q7, Q8 and associated components. Also check for short in U1 and shorted filter capacitors.
OK
Check voltage at TP20.
Not OK
Check Q9, Q10 and associated components. Also check for short in U2 and associated components.
OK
Turn RECEIVER MODE to EXT; set Gain about 3/4 of maximum. Inject noise at base of Q4 (junction of R16 and R18). See para. 5-19.
Noise or meter indication
Defective RF, IF or oscillator stages. See Table 5-3.
No noise or meter indication.
Defective audio section. See Table 5-2.

Table 5-2. Audio Troubleshooting

NOTE

Follow procedures in Table 5-1 before using this table.


ENTER FROM TABLE 5-1
Inject a 500 Hz, .05V p-p signal at TP10 with signal generator. Use 1000Ω resistor for isolation.
*Check TP15
Not OK
Isolate trouble to Q4, Q5 or Q6 and/or associated components by checking voltages. Replace Q4-Q6 and associated components as necessary. Check 3 dB points @ 500 and 600 Hz.
OK
(typically 0.04V p-p)
*Check TP17
Not OK
Check and replace passive components associated with U1 pins 14 and 15, as required.
Components OK
Replace U1
OK
(typically 0.09V p-p)
Check signal & dc levels at TP18 & TP19.
Not OK
Check U2 and associated components. Also check loudspeaker and its connections.

* Use oscilloscope.

Table 5-3. RF/IF/Oscillator Troubleshooting

NOTE

Follow procedures in Table 5-1 before using this table.

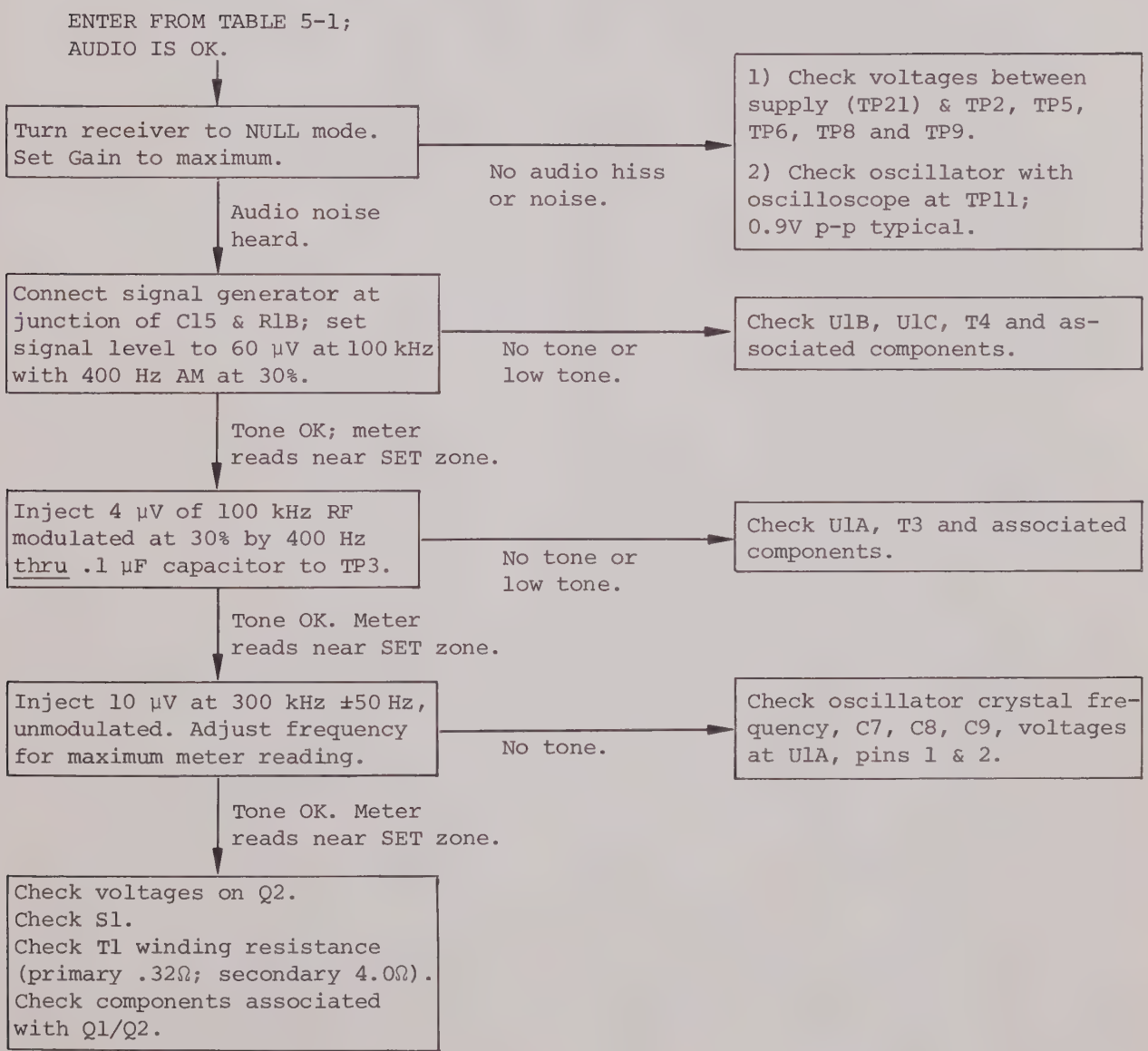
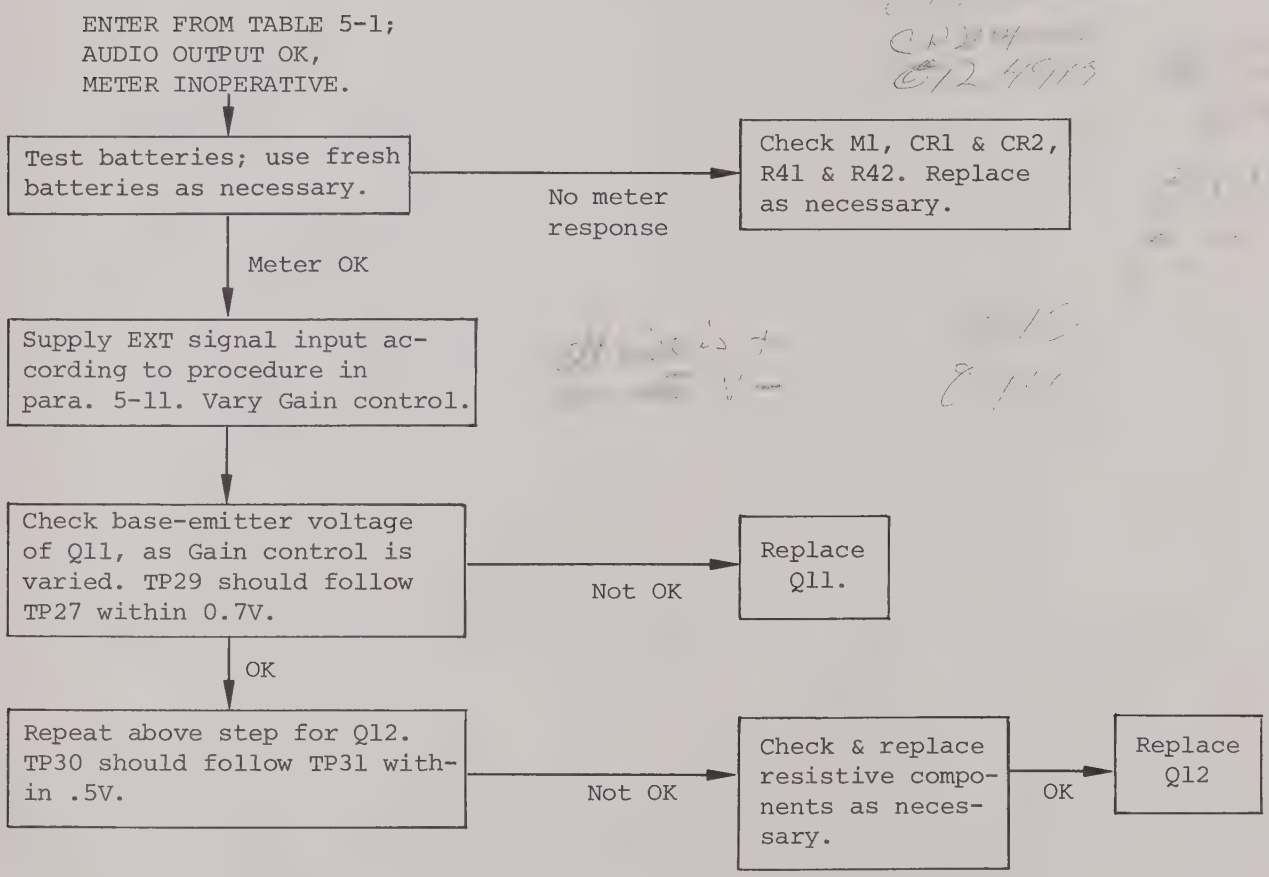

ENTER FROM TABLE 5-1; AUDIO IS OK.
Turn receiver to NULL mode. Set Gain to maximum.
No audio hiss or noise.
1) Check voltages between supply (TP21) & TP2, TP5, TP6, TP8 and TP9.
2) Check oscillator with oscilloscope at TP11; 0.9V p-p typical.
Audio noise heard.
Connect signal generator at junction of C15 & R1B; set signal level to 60 µV at 100 kHz with 400 Hz AM at 30%.
No tone or low tone.
Check U1B, U1C, T4 and associated components.
Tone OK; meter reads near SET zone.
Inject 4 µV of 100 kHz RF modulated at 30% by 400 Hz thru .1 µF capacitor to TP3.
No tone or low tone.
Check U1A, T3 and associated components.
Tone OK. Meter reads near SET zone.
Inject 10 µV at 300 kHz ±50 Hz, unmodulated. Adjust frequency for maximum meter reading.
No tone.
Check oscillator crystal frequency, C7, C8, C9, voltages at U1A, pins 1 & 2.
Tone OK. Meter reads near SET zone.
Check voltages on Q2.
Check S1.
Check T1 winding resistance (primary .32Ω; secondary 4.0Ω).
Check components associated with Q1/Q2.

Table 5-4. Meter Circuit Troubleshooting

NOTE

Follow procedures in Table 5-1 before using this table.


ENTER FROM TABLE 5-1; AUDIO OUTPUT OK, METER INOPERATIVE.
Test batteries; use fresh batteries as necessary.
No meter response
Check M1, CR1 & CR2, R41 & R42. Replace as necessary.
Meter OK
Supply EXT signal input according to procedure in para. 5-11. Vary Gain control.
Check base-emitter voltage of Q11, as Gain control is varied. TP29 should follow TP27 within 0.7V.
Not OK
Replace Q11.
OK
Repeat above step for Q12. TP30 should follow TP31 within .5V.
Not OK
Check & replace resistive components as necessary.
OK
Replace Q12

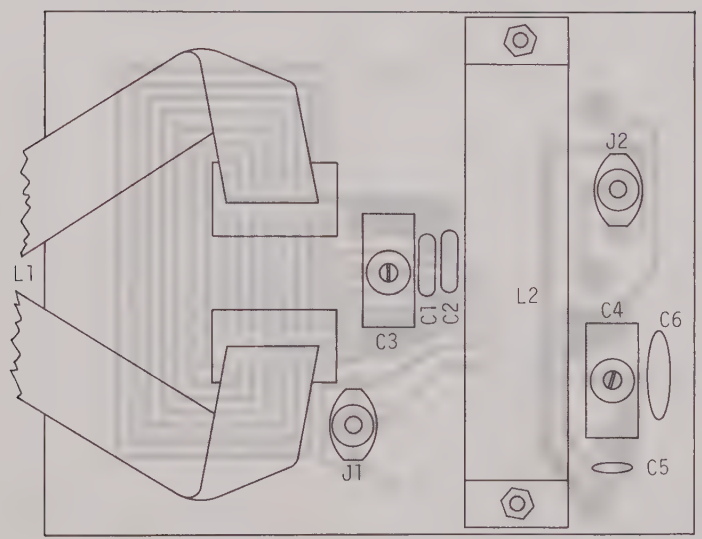


Figure 5-1. Receiver Antenna Assembly A2A1 Assembly Diagram

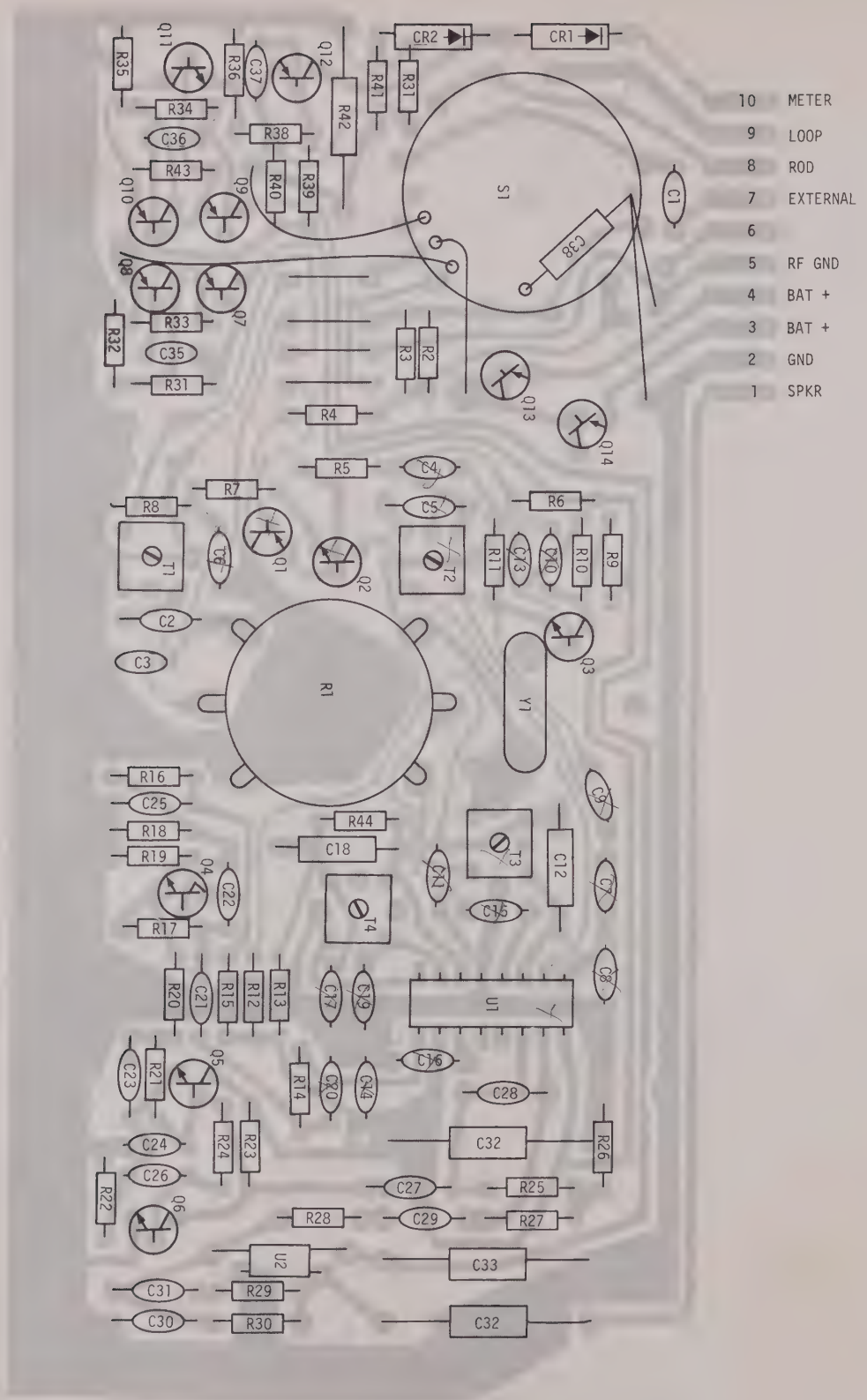


Figure 5-2. Receiver Circuit Assembly Diagram

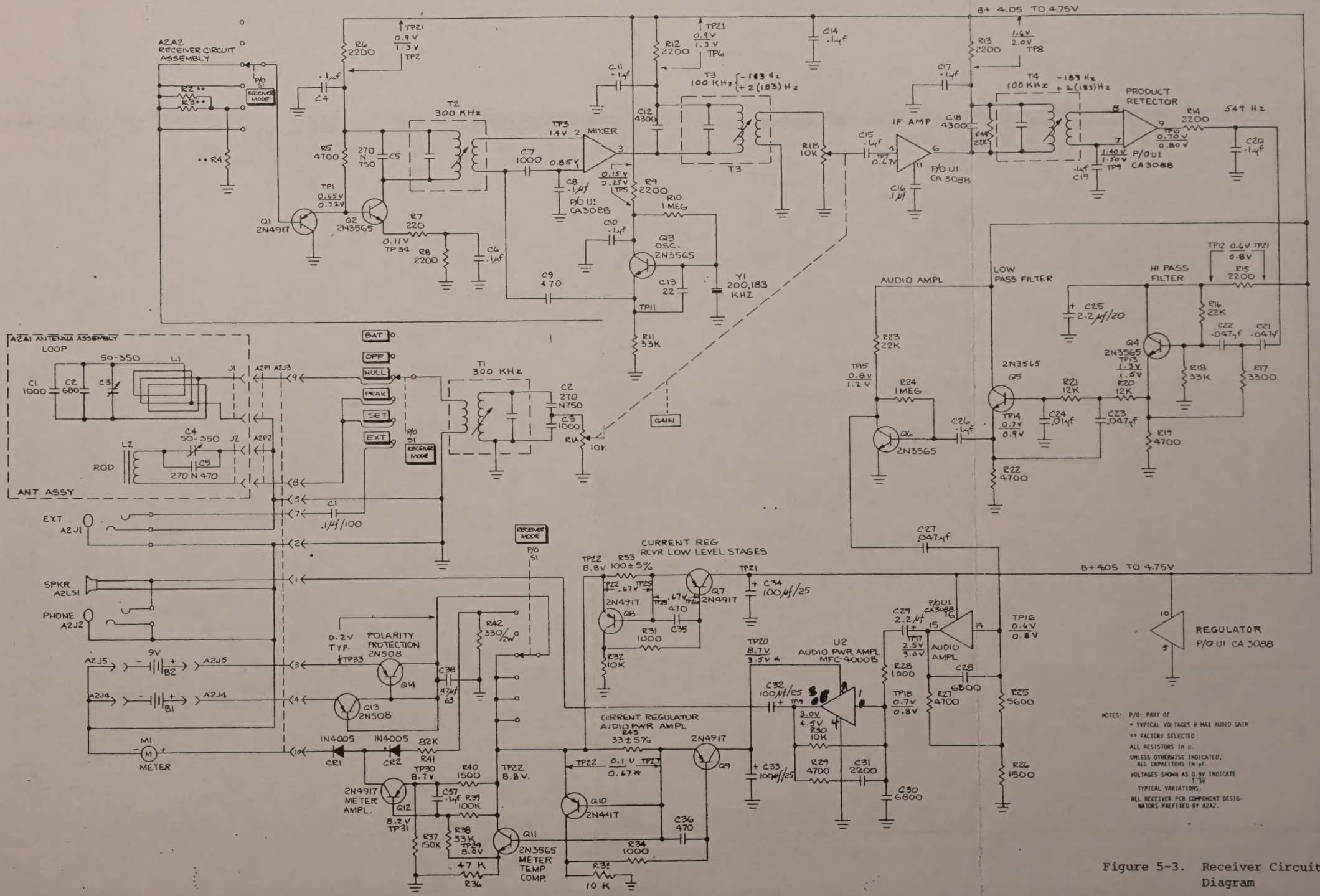
TABLE 5-5. PARTS LIST, RECEIVER ASSEMBLY A2*

Circuit Ref.	Description	Dynatel Part No.	Manufacturer	Manufacturer's Part No.
A2A1	Antenna Assy	9080-0040	Dynatel	
C1	1000 pF ±5%	2023-4105	C-D	DM-15
C2	680 pF ±5%	2023-3685	C-D	DM-15
C3	50-350 pF variable	2703-3359	El Menco	428
C4	50-350 pF variable	2703-3359	El Menco	428
C5	270 pF ±5% N470	2105-3274	RMC	2% N470 ±5%
J1,J2	Phono Jack	5200-1007	Molex	A2181
L1	Antenna Loop Assembly	5941-0001	Spectra Strip	5142-036
L2	Antenna Assy, Ferrite	4510-0001	Miller	2005
A2A2	Receiver Circuit Assy	9010-0021	Dynatel	
C1	.1, ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C2	270 pF ±5%, N750	2105-3275	RMC	270N750 ±5%
C3	1000 pF ±5%, 100V	2023-4105	Cornell-Dubilier	DM-15
C4	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C5	270 pF ±5%, N750	2105-3275	RMC	270N750 ±5%
C6	.1 ±10%, 100V	2035-6106	Stettner-Trush	MKT1819
C7	1000 pF ±5%, 100V	2023-4105	Cornell-Dubilier	DM-15
C8	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT1819
C9	470 pF ±5%, 500V	2025-3475	Cornell-Dubilier	DM-15
C10,C11	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C12	4300 pF ±5%, 100V	2073-4435	Siemens	B31310A
C13	22 pF ±5%, 500V	2025-2225	Cornell-Dubilier	DM-15
C14 thru C17	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C18	4300 pF ±5%, 100V	2073-4435	Siemens	B31310A
C19,C20	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C21 thru C23	.047 ±10%, 250V	2034-5476	Stettner-Trush	MKT-1822
C24	.01 ±10%, 100V	2033-5106	Stettner-Trush	MKT-1819
C25	2.2 ±10%, 20V Tant.	2551-1226	Dickson	CS13BE
C26	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C27	.047 ±10%, 250V	2034-5476	Stettner-Trush	MKT-1822
C28	6800 pF ±10%, 400V	2035-4686	Stettner-Trush	KC-1807
C29	2.2 ±10%, 20V, Tant.	2551-1226	Dickson	CS13BE
C30	6800 pF ±10%, 400V	2035-4686	Stettner-Trush	KC1807
C31	2200 pF ±10%, 400V	2035-4226	Stettner-Trush	KC1849
C32	100, 25V electrolytic	2501-3109	Siemens	B41283
C33	100, 25V electrolytic	2501-3109	Siemens	B41283
C34	100, 25V electrolytic	2501-3109	Siemens	B41283
C35,C36	470 pF ±10%	2017-3476	Centralab	DD471
C37	.1 ±10%, 100V	2033-6106	Stettner-Trush	MKT-1819
C38	.47 ±20%, 63V	2032-6477	Stettner-Trush	MKT-1819
CR1,CR2	1N4005	1200-0003	General Inst.	1N4005
Q1	2N4917	1401-0001	Fairchild	2N4917
Q2 thru Q6	2N3565	1400-0002	Fairchild	2N3565
Q7 thru Q10	2N4917	1401-0001	Fairchild	2N4917
Q11	2N3565	1400-0002	Fairchild	2N3565
Q12	2N4917	1401-0001	Fairchild	2N4917
Q13,Q14	2N508 or 2N396	1301-0001	G.E.	2N396
*R1A,R1B	Potentiometer, 10K Audio Tapes	3804-9001	CTS	EF9998
R2 thru R4	Factory selected	—	—	—
R5	4700 ±5%	3013-4475	Roederstein	SK-2
R6	2200 ±5%	3013-4225	Roederstein	SK-2
R7	220	3013-3225	Roederstein	SK-2
R8,R9	2200	3013-4225	Roederstein	SK-2

* Unless otherwise specified, all capacitors in μF; all resistors in Ω, 1/4W, 5%, carbon composition.

TABLE 5-5 (Cont)

Circuit Ref.	Description	Dynatel Part No.	Manufacturer	Manufacturer's Part No.
R10	1M	3013-7105	Roederstein	SK-2
R11	33K	3013-5335		
R12thru R15	2200	3013-4225		
R16	22K	3013-5225		
R17	3300	3013-4335		
R18	33K	3013-5335		
R19	4700	3013-4475		
R20,R21	12K	3013-5125		
R22	4700	3013-4475		
R23	22K	3013-5225		
R24	1M	3013-7105		
R25	5600	3013-4565		
R26	1500	3013-4155		
R27	4700	3013-4475		
R28	1000	3013-4105		
R29	4700	3013-4475		
R30	10K	3013-5105		
R31	1000	3013-4105		
R32	10K	3013-5105		
R33	100 ±5%	3013-3105		
R34	1000	3013-4105		
R35	10K	3013-5105		
R36	47K	3013-5475		
R37	150K	3013-6155		
R38	33K	3013-5335		
R39	100K	3013-6105		
R40	1500	3013-4155		
R41				
R42	330 ±10%, 2W	3015-3336		
R43	33 ±5%	3013-2335	Roederstein	SK-2
S1	Switch Assembly	5500-9017	CTS	X5P5728
T1,T2	RF Transformer,300 kHz	4500-0001	Tolco	YMC 14601A
T3,T4	IF Transformer,100 kHz	4500-0001	Tolco	YMC 14601A
U1	CA 3088	1700-0006	RCA	CA 3088
U2	MFC-4000B	1700-0005	Motorola	MPS-U01
Y1	Crystal, 200.183 kHz	5410-0002	Bulova	CR46-A/U
A2B1,A2B2	9V Battery	5100-0002		NEDA 1602, or equiv.
A2J1,A2J2	3-conductor Phone Jack	5200-1004	Switchcraft	
A2J3	10-pin Edge-type PC Connector	5200-0110	ELCO	00-6007-010-940-002
A2J_	Battery Connector(s)	5102-0002	Smith	1234LL
A2LS1	Speaker, 2-1/2" dia; 8Ω	5430-0001	G.C.	S2-205
A2M1	Meter Assembly	5400-9004	Dynatel	
A2P1,P2	Plug	5200-1008	NTT	36C
A2W1	Wire Harness Assy	5940-9006	Dynatel	



NOTES: P/O: PART OF
* TYPICAL VOLTAGES @ MAX AUDIO GAIN
** FACTORY SELECTED
ALL RESISTORS IN Ω.
UNLESS OTHERWISE INDICATED, ALL CAPACITORS IN pF.
VOLTAGES SHOWN AS 0.9V INDICATE 1.3V TYPICAL VARIATIONS.
ALL RECEIVER PCB COMPONENT DESIGNATORS PREFIXED BY A2A2.

Figure 5-3. Receiver Circuit Diagram

MP MASTER
MA31882